# 5. Isothermal process

## 5.1. Introduction

The aim of the experiment is verification of the Boyle– Mariotte law, i.e. the isothermal process (T=idem), expressed with equation:

$$p_i V_i = idem$$

## 5.2. The experiment station description

The experiment station contains the elastic U-tube manometer, partially filled with mercury (fig. 1). The rigid left arm of U-tube manometers is ended with a valve (*Z)* opened and closed manually. Closing the valve causes occurrence of a reservoir of the gas. The reservoir has constant cross section and adjustable, by mercury meniscus positioning, height $(L_i)$. The change of meniscus position is obtained by moving the right arm of the manometer.

## 5.3. Experiment description

During the experiment the volume of the gas reservoir above the mercury meniscus in the left arm of the U-tube manometer shall be increased by lowering the right arm of the manometer. The volume of the gas is proportional to the height of the reservoir $(L_i)$.

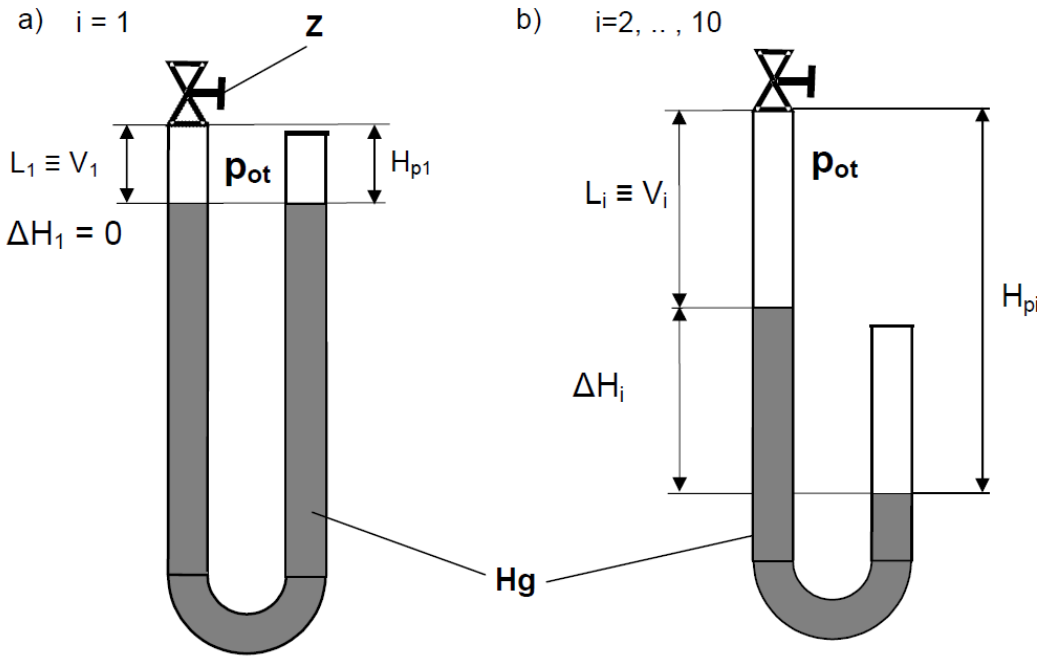


Figure 1. The schematic representation of the test station

The tested gas (air) is in the left arm of the U-tube (fig. 1a). The initial pressure (i=1) is equal to the ambient pressure $p_1=p_0$ (valve opened). The gas volume change is performed after closing the valve *(Z)*, before lowering the right arm of the U-tub (fig. 1b). The height of the mercury meniscus $(H_{pi})$ shall be determined for few corresponding, arbitrary values of $(L_i)$. The value of pressure( $p_i$) of the gas in the reservoir in left arm of the U–tube is the algebraic sum of the ambient pressure $p_{ot}$ and pressure which represents the height of mercury column ($\Delta H_i$) in the U-tube (fig. 1b:the density of mercury is $\rho = 13{,}6\,{}^{g}/_{cm^3}$, gravitational acceleration is $g = 9{,}81\,{}^{m}/_{s^2}$)

### 5.4. Elaboration of results

### Lab_5 Isothermal process

Group ……..date: ……. hour:…….

| **Date: ..... $p_{ot}$= ..... $t_{ot}$= ..... $T_{ot}$= .....** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **i** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| $L_i$ mm | | | | | | | | | | |
| $H_{pi}$ Mm | | | | | | | | | | |
| $\Delta H_{pi}$ mmHg | | | | | | | | | | |
| $P_i$ MPa | | | | | | | | | | |
| X | | | | | | | | | | |
| Y | | | | | | | | | | |

Based on obtained resold calculate the pressure of tested gas $p_i$

1. Present the results as dependence Y=f(X) on a coordinate system, where:

$$X = \frac{L_1}{L_i}$$

$$Y = \frac{p_i}{p_1}$$

2. Establish the trend line as a representation of first degree polynomials as well as $R^2$.

If the law of Boyle– Mariotte is fulfilled, the points on the coordinate system should be gathered around straight line which starts at the beginning of the system.